Draft

Basis of Design
Remedial Action for SWMU 31/32

Naval Station Roosevelt Roads

RCRA/HSWA Permit No. PR2170027203

Ceiba, Puerto Rico

Prepared For

Department of the Navy

Atlantic Division
Naval Facilities Engineering Command

Norfolk, Virginia

Contract No. N62470-95-D-6007
CTO-0033

August 14, 2000

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TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

AFWTF	Atlantic Fleet Weapons Training Facility
AOC	Area of Concern
Baker	Baker Environmental, Inc.
bgs	below ground surface
CMS	Corrective Measures Study
cPAH	carcinogenic polyaromatic hydrocarbons
CTO	Contract Task Order
DoN	Department of the Navy
HTRW	hazardous, toxic, and radiological waste
LANTDIV	Atlantic Division, Naval Facilities Engineering Command
Fg/L	micrograms per liter
NEESA	Naval Energy and Environmental Support Activity
NFESC	Naval Facilities Engineering Service Center
NSRR	Naval Station Roosevelt Roads
NTR	Navy Technical Representative
PCB	polychlorinated biphenyl
PPE	personal protective equipment
ppm	parts per million
RAC	Remedial Action Contractor
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
SWMU	solid waste management unit
SVOCs	semivolatile organic compounds
TOC	total organic carbon
VOCs	volatile organic compounds

1.0 INTRODUCTION

This document presents the Basis of Design for the capping and isolation of dioxin contaminated surface soils at Solid Waste Management Unit (SWMU) 31/32 at Naval Station Roosevelt Roads (NSRR), Ceiba, Puerto Rico.

NSRR occupies over 33,500 acres on the northern side of the east coast of Puerto Rico, along Vieques Passage with Vieques Island lying to the east about 10 miles off the harbor entrance. The north entrance to NSRR is about 35 miles east along the coast road (Route 3) from San Juan. The closest large town is Fajardo (population approximately 37,000), which is about 10 miles north of NSRR off Route 3. Ceiba (population approximately 17,000) adjoins the west boundary of NSRR (see Figure 1-1).

The location of SWMUs 31/32 are shown on Figure 1-2. A site plan of SWMUs 31/32 is presented as Figure 1-3. Based on results of past investigations conducted on surface soils at these SWMUs, no dioxin toxicity equivalents (TEQs) are greater than the action level of 1 part per billion (ppb), therefore public health action is not necessary.

This Basis of Design document has been prepared by Baker Environmental, Inc. (Baker) under Contract to the Naval Facilities Engineering Command, Atlantic Division (LANTDIV), Contract Number N62470-95-D-6007, Contract Task Order (CTO) Number 0033.

The Remedial Action Contracts Delivery Order Requirements Package Guide, Naval Energy and Environmental Support Activity (NEESA) 20.2-062 dated June 1992 was used as guidance in preparing this report.

As LANTDIV and NSRR intend to use a Remedial Action Contractor (RAC) to implement the Removal Action, the terms "RAC" and "Contractor" are used interchangeably in this document.

1.1 Purpose of the Basis of Design

The primary purposes of the Basis of Design are to present LANTDIV and NSRR with background data on the project, describe the primary elements of the remedial design, recommend criteria, and present assumptions and any special requirements that may affect the design. This document is not intended to be part of the construction plans or technical specifications to be utilized by the RAC for execution of

the Remedial Action. Baker assumes no responsibility for the use of this report for any purpose other than the intended uses stated above.

2.0 BACKGROUND INFORMATION

This section provides site descriptions, site histories, and summaries of pertinent environmental investigations and actions conducted at each site.

2.1 Site Descriptions and History

The following subsections detail the general history and describe the features of NSRR and of SWMUs 31/32.

2.1.1 NSRR

NSRR was commissioned in 1943 as a Naval Operations Base, and redesignated a Naval Station in 1957. The current primary mission of NSRR is provision of full support for Atlantic Fleet Weapons Training Facility (AFWTF) and development activities. NSRR has administrative and command responsibilities for some operations separated from the main base on Vieques Island.

2.1.2 SWMUs 31/32 Description and History

SWMUs 31/32 are located in the Public Works Department (PWD) operations yard, which is in the eastern portion of the Station, northeast of Forrestal Drive. The operations yard is used by the transportation shop to service Station vehicles. In general, SWMUs 31/32 includes a small open parking/storage area surrounding a canopy area attached to the northern corner of PWD Building 31. In addition to PWD Building 31, Buildings 1926 and 2022 (Paint Shop) and a storage building are located within and/or adjacent to the SWMUs 31/32 area. SWMUs 31/32 is used for the management of waste vehicle oils in limited quantities. SWMU 32 was identified in previous investigations as a former battery storage area. The area is currently used for storage of heavy equipment. The majority of the area at SWMUs 31/32 is asphalt-paved. The area immediately north west of the SWMUs is not covered. Figure 1-3 shows a site plan of SWMUs 31/32.

2.2 Summary of Previous Environmental Investigations, Evaluations, and Activities

A number of environmental investigations have been conducted at SWMUs 31/32. The following sections summarize these investigations.

2.2.1 Investigation History

The SWMUs 31/32 area will include the general area surrounding the northern corner of PWD Building 31. This area includes the area previously investigated as SWMU 31 and SWMU 32 in addition to the area in between these two SWMUs. The histories of the SWMUs, as well as summaries of previous investigations, are discussed in the following paragraphs.

2.2.2 RCRA Facilities Investigation

A two-phase RCRA Facility Investigation (RFI) was conducted at SWMUs 31/32 in 1995 and 1997 and an additional dioxin investigation completed in June 1999 as discussed below.

2.2.2.1 Phase I RFI

The initial RFI for NSRR was conducted in 1995. This RFI is also known as the Phase I RFI. Several SWMUs and AOCs were investigated under this RFI including SWMUs 31/32. The objective of this investigation was to assess whether a release had occurred at any of the SWMUs or AOCs. The Draft RFI Report was submitted in July 1996 (Baker, 1996). Several of the SWMUs/AOCs investigated were found to require some additional confirmatory sampling or further site characterization. Therefore, additional RFI activities were conducted at these SWMUs/AOCs (Phase II).

Under the Phase I RFI, four surface soil samples were collected at SWMUs 31/32 (31SS01 through 31SS04). These samples were collected at locations immediately surrounding the Building 31 canopy area. These four samples were collected at a depth of 0 to 1 feet below ground surface (bgs) and were analyzed for the full Appendix IX list (including dioxins and furans) and total petroleum hydrocarbons. Figure 2-1 identifies the location of the Phase I samples.

Dioxins were detected in two of the four Phase I surface soil samples. The detected dioxins/furans included total hexachlorodibenzo-p-dioxin (HxCDD), total hexachlorodibenzofuran (HxCDF), total pentachlorodibenzo-p-dioxin (PeCDD), total pentachlorodibenzofuran (PeCDF), and total tetrachlorodibenzofuran (TCDF). The analytical sample results from Phase I are presented on Table 2-1. As shown on the table, two of the samples contained detected concentrations of dioxins/furans. Sample 31SS02 contained HxCDF at a concentration of 0.06J micrograms per kilogram (: g/Kg). The J value indicates that the reported value is estimated, and it may not be accurate or precise. Sample 31SS04

contained HxCDD (12 : g/Kg), HxCDF (43 : g/Kg), PeCDD (0.74J : g/Kg), PeCDF (3.1 : g/Kg), and TCDF (0.17J : g/Kg).

For SWMUs 31/32. The Draft RFI (Phase I) Report indicated that there were no unacceptable risks posed by the SWMUs for continued industrial use. However, during the review of the Draft Report, dioxin values to be used for the risk assessment changed. This change caused the risk assessment to be recalculated using the new values. The revised risk assessment results indicated a slight potential risk to on-site workers posed by the dioxin levels identified at the SWMUs (specifically from sample location 31SS04). It should be noted that dioxin wastes were never reportedly managed at the SWMUs or did waste burning activities ever take place at or near the SWMUs. The results of the recalculated human health risk assessment indicated the need to perform additional dioxin-related sampling at SWMUs 31/32.

2.2.2.2 Phase II RFI

Based on the results of the Phase I RFI, additional RFI investigations were conducted at SWMUs 31/32 (in conjunction with five other SWMUs and three AOCs) at the request of the USEPA. This additional work was undertaken in the fall of 1997, based on an USEPA approved RFI work plan addendum (Baker, 1997). For purposes of this report, this additional RFI investigation will be considered the Phase II RFI.

At SWMUs 31/32, eight surface soil samples were collected during the Phase II RFI: 31-SS05 through 31-SS12. These surface soil samples were collected at a depth of 3 to 9 inches bgs, and they were analyzed for dioxins/furans only. Figure 2-1 identifies the location of these Phase II samples. It appeared based on the Phase I RFI, that only dioxins may be a potential concern at SWMUs 31/32.

Dioxins/furans were detected in six of the eight Phase II surface soil samples. The detected dioxins/furans included total HxCDD, HxCDF, PeCDF, and TCDF. The detected analytical sample results from Phase II are presented on Table 2-2. As shown on the table, the ranges of detections for each of the compounds are as follows:

- Total HxCDD 0.16J – 1.5J : g/Kg
- Total HxCDF 0.10J – 3.3 : g/Kg

- Total PeCDF 0.07J – 1.10 : g/Kg
- Total TCDF 0.04J – 0.15J : g/Kg

A human health risk assessment was conducted on the Phase I and Phase II surface soil samples analyzed for dioxins/furans. Potentially unacceptable carcinogenic risks were estimated for current on-site workers and future adult and young child residents. The potential risk was predominantly driven by dermal and ingestion exposures to total HxCDF, PeCDF, and HxCDD in soil. The calculated incremental lifetime cancer risks (ILCRs) were 2.3×10^{-04} for the on-site worker, 3.8×10^{-04} for the future adult resident, and 4.3×10^{-04} for the future child resident.

The recommendations presented in the Draft Additional Facility Investigation Report for Operable Units 1, 6, and 7 (i.e., the Phase II RFI) for SWMUs 31/32 included no further action. Under this scenario, the DoN proposed to place the SWMUs under a land-use restriction that would negate the potential risks posed to future residents. The potential risk to the current on-site worker would be mitigated by the fact that significant portions of the SWMU area are paved, and where unpaved, the material is hard packed and does not generally produce dust when windblown or transited. Therefore, a complete exposure pathway to the dioxins would be difficult to establish.

On September 15, 1998, the USEPA requested that SWMUs 31/32 be evaluated further through the performance of a CMS. During the development of the CMS, it was determined that site specific cleanup levels could not be established utilizing the non-congener specific analytical Method 8280. Site-specific risk-based levels may not be measurable and/or achievable with available technologies. The Navy proposed to perform additional sampling in the area of the dioxin detections to accomplish a two fold purpose. First, samples were to be obtained from previous sampling locations and subjected to analysis for the specific dioxin congeners (Method 8290). This provided more specific information for the development of potential cleanup levels. Second, samples were to be obtained from points further away from the building in an effort to quantify the affected area. A work plan for this additional work (Baker, 1999) was submitted to the USEPA and subsequently approved by the USEPA in June 1999.

2.2.3 Additional Dioxin Investigation

In June 1999, 18 additional surface soil samples and two duplicates samples were collected at SWMUs 31/32 to confirm some of the older data and to further delineate the extent of the dioxin contamination. The samples included 31-SS04A through 31-SS08A, 31-SSA through 31-SSG, and 31-SSAA through

31-SSFF as shown on Figure 2-2. The samples were collected at depths of 3.0 to 9.0 inches bgs. Five of these samples (31-SS04A through 31-SS08A) were collected at locations similar to sample locations 31-SS04 through 31-SS08 from the previous RFI investigations.

The soil samples collected during this 1999 sampling event were analyzed for the dioxin and furan congeners as per USEPA SW-846 Method 8290 (Table 2-3 lists these congeners). This analytical method includes several congeners that are not included in the standard dioxin/furan method (Method 8280). Table 2-4 presents a summary of the analytical data from the 1999 sampling. Both individual congener concentrations and total concentrations are presented on the table where applicable.

As shown on the table, dioxins/furans were detected in every sample. Total tetrachlorodibenzo-p-dioxin (TCDD) concentrations ranged from not detected to 0.11 : g/Kg. Total TCDF concentrations ranged from not detected to 100 : g/Kg. Total PeCDD concentrations ranged from not detected to 0.61 : g/Kg. Total PeCDF concentrations ranged from 0.00052 to 1.8 : g/Kg. Total HxCDD concentrations ranged from 0.00062 to 1.1 : g/Kg. Total HxCDF concentrations ranged from 0.00056 to 2.8 : g/Kg. Total heptachlorodibenzo-p-dioxin (HpCDD) concentrations ranged from 0.0039 to 1,300 : g/Kg. Total heptachlorodibenzofuran (HpCDF) concentrations ranged from 0.0019 to 52 : g/Kg. Total octachlorodibenzo-p-dioxin (OCDD) concentrations ranged from 0.018 to 900 : g/Kg. Total octachlorodibenzofuran (OCDF) concentrations ranged from 0.001 to 46 : g/Kg.

3.0 FACTORS AFFECTING THE DESIGN AND IMPLEMENTATION OF THE CORRECTIVE ACTION

The following sections describe factors affecting the design and implementation of the proposed Corrective Action – isolate the surface soil by constructing an asphalt cap. Supporting information and referenced data are presented in the Appendices as follows.

- Appendix A - Construction Schedule
- Appendix B - Supporting Calculations

3.1 Scope and Goals of the Proposed Corrective Action

The proposed asphalt cap corrective action for SWMUs 31/32 will provide a cost-effective means of meeting the overall project goal, which is the protection of human health and the environment.
After completion of the asphalt cap, no further corrective action is recommended for SWMUs 31/32. The majority of the area within SWMUs 31/32 is currently covered with asphalt. This asphalt barrier mitigates the exposure pathway for dermal contact with the surface soil at the SWMUs. The remaining small area (approximately 5,400 square feet) within SWMUs 31/32 is not paved with asphalt. As a corrective action, an asphalt pavement cap will be constructed over this earthen area. This area includes one of the localized areas where the dioxin TEQs are greater than 50 ppt. The asphalt will provide a barrier to mitigate a potential exposure pathway. In addition to the construction of the asphalt pavement, the existing pavement and new pavement will be maintained to protect the integrity of the cap. Land use controls will also be implemented to prevent the use of this SWMU for residential housing.

3.2 Descriptions of the Proposed Corrective Action

The major items associated with the proposed Corrective Action for SWMUs 31/32 include:

- Raise the manhole covers and storm water catch basins within the proposed asphalt cap area. Manhole covers and catch basins grates must be extended to provide positive drainage after installation of the asphalt pavement.

- Place and compact the stone base course to the limits of the asphalt cap. The base course must be graded to provide positive drainage as indicated on the design drawings. Maintain the required minimum thickness of base course. Add base course material as necessary to achieve the required grade.

- Place and compact the bituminous concrete surface course of the asphalt cap. Apply a bituminous tack coat to the surface of existing pavement where the edge of the asphalt cap overlays the existing pavement.

3.3 Preliminary Design Criteria and Rationale

The following criteria were used to develop the Basis of Design Removal Action:

Technical Consideration - The justification for the selection of no further action as the corrective measure after completion of the asphalt cap, is presented in the following subsections. The corrective measure will be evaluated based upon technical, human health and environmental considerations.

The corrective action for SWMUs 31/32 is technically very easy to implement. Soil excavation and treatment/disposal actions are not necessary. A small area within the SWMUs will be asphalt paved. This pavement will connect with the existing pavement within the operation yard. Paving techniques are widely used and readily available.

Human Health Considerations – The action level of 1 ppb TEQ dioxin was established by ATSDR for residential soil to be protective of human health. Based on the most recent dioxin data collected from the SWMU, all of the samples contained TEQs of TCDD; less than 1 ppb. Therefore, the design corrective action is protective of human health.

In addition to the ATSDR action levels, a cursory review of CERCLA Records of Decision (RODs) for dioxin contaminated sites was conducted. This review was conducted on the USEPA Internet Site (USEPA, 1999). The results of this cursory review indicated that the dioxin cleanup levels were typically set at 1 ppb. Occasionally, cleanup levels as high as 20 ppb were documented. Therefore the use of 1 ppb as the cleanup level for SWMU 31/32 appears to be appropriate.

Environmental Considerations – The recommended corrective action for SWMUs 31/32 will provide an ecological benefit. Earth-disturbing activities will not be necessary since the dioxin detections are below the action level of 1 ppb TEQ of TCDD. The asphalt pavement will provide additional protection to potential terrestrial receptors by mitigating the exposure pathway for dermal contact and ingestion.

3.4 General Operations and Maintenance Requirements

Minimal maintenance will be required subsequent to implementation of the corrective action. Periodic visual inspections should be conducted to verify the integrity of the asphalt pavement cap. Any areas of the cap that exhibit signs of cracking or structural failure may be repaired by the NSRR Public Works Department or a landscaping subcontractor.

4.0 REMEDIAL ACTION WORK BREAKDOWN STRUCTURE

The following sections of this Basis of Design describe the Removal Actions by hazardous, toxic, and radiological waste (HTRW) account numbers, as defined by the Remedial Action Contracts Delivery Order Requirements Package Guide, Parts 1 and 2, NEESA 20.2-062, dated June 1992.

4.1 33.01 - Mobilization and Preparatory Work

Mobilization involves the acquisition, delivery, and setup of equipment, material, and personnel at the work site, which are necessary to accomplish the scope of work outlined for the removal actions.

In addition, during the mobilization period, the Contractor shall prepare all necessary pre-construction submittals as described in Section 01115, "General Paragraphs" of the Technical Specifications. These specifications allow the Contractor up to sixty (60) days to prepare and submit the necessary pre-construction submittals. These submittals include:

- Site Health and Safety Plan
- General Site Work Plan
- Construction Quality Control Plan
- Shop Drawings
- Supplemental Specifications and Calculations
- Site Visit, Miscellaneous

The Contractor shall provide temporary facilities at each site, including (but not limited to) equipment and material storage areas. The Contractor will also provide any temporary utilities required at the individual sites necessary to complete the work.

The Contractor will be required to coordinate and obtain any necessary construction permits (such as temporary road closure permits) and clearances prior to the start of construction. The Contractor will also be responsible for coordinating all required inspections with NSRR=s Public Works Department.

4.2 33.02 - Monitoring, Sampling, Testing, and Analysis

The RAC will be responsible for all health and safety monitoring at SWMUs 31/32. Sampling, testing and analysis that will be conducted by the RAC will include thickness and in place field density testing, etc.

The type and quantity of testing will be based on the requirements set forth in the specifications. All required testing, documentation, and submittal of test results (for samples collected by the Contractor) will be the responsibility of the Contractor.

4.3 33.03 - Site Work

Site work includes, but is not limited to, the following activities:

- Raising of manhole and catch basin cover and grates
- Placement, grading and compaction of the stone base course component of the asphalt pavement
- Installation of bituminous concrete surface course and bituminous tack coat at areas of existing pavement overlay

4.4 33.17 – Decontamination and Decommissioning

Demolition of structures is not anticipated. Drums, tanks, or spent personnel protective equipment (PPE), and other non-hazardous solid waste will be disposed of in accordance with USEPA Guidance (USEPA Publication 9345.3-05FS).

4.5 33.18 - Disposal

The following materials will be containerized and transported to an approved treatment or disposal facility off-base:

- Contractor-generated waste (e.g., excess base course or bituminous materials).

4.6 33.20 - Site Restoration

After installation of the asphalt pavement cap SWMUs 31/32 will be restored as indicated on the design drawings and in the technical specifications.

4.7 33.21 - Demobilization

All temporary facilities, equipment, and supplies acquired for this contract shall be removed from the site upon completion of the asphalt pavement cap installation.

Post-construction submittals will include:

1) a letter from the Contractor certifying completion of all contracted work in accordance with the contract conditions, applicable regulations, and standards of practice;

2) submittal, in one collated document, of all quality control daily reports manifests, corrective actions taken to correct unacceptable deviations from required quality standards (if required) results of corrective actions; problems encountered and resolved, and lessons learned.

The Contractor will submit a detailed report summarizing the asphalt pavement cap, lessons learned, and recommendations for inclusion in future similar contracts.

5.0 REFERENCES

Baker Environmental, Inc. (Baker). 1999. Workplan for Additional Dioxin Sampling at SWMUs 31/32/32, Naval Station Roosevelt Roads, Ceiba, Puerto Rico. Prepared for the Department of the Navy Atlantic Division, Naval Facilities Engineering Command, Norfolk, Virginia. Contract N62470-89-D-4814. CTO-0223. May 28, 1999.

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USEPA. 1999. Record of Decision (ROD) Abstracts. http://www.epa.gov/oerrpage/Superfund/sites/rodsites/.htm accessed December 16, 1999.

TABLES

TABLE 2-1

SUMMARY OF PHASE I RFI DIOXIN ANALYTICAL RESULTS
SWMUs 31/32
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

Sample ID	31SS01	31SS02	31SS03	31SS04
Sample Date	10/31/95	10/31/95	10/31/95	10/31/95
Depth Range (ft bgs)	0.00-1.00	0.00-1.00	0.00-1.00	0.00-1.00
Dioxins (ug/kg)				
Total HxCDD	0.10 U	0.06 U	0.06 U	12.0
Total HxCDF	0.10 U	0.06 J	0.06 U	43.0
Total PeCDD	0.13 U	0.09 U	0.07 U	0.74 J
Total PeCDF	0.07 U	0.06 U	0.06 U	3.10
Total TCDF	0.06 U	0.05 U	0.04 U	0.17 J

Data Qualifiers:
J = Analyte present. Reported value may not be accurate or precise.
U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.
UJ = Not Detected. Quantitation limit may be inaccurate or imprecise.

Notes:
HxCDD = Hexachlorodibenzo-p-dioxin
HxCDF = Hexachlorodibenzofuran
PeCDD = Pentachlorodibenzo-p-dioxin
PeCDF = Pentachlorodibenzofuran
TCDF = Tetrachlorodibenzofuran

ug/kg = micrograms per kilogram
ft bgs = feet below ground surface

TABLE 2-2

SUMMARY OF PHASE II RFI DIOXIN ANALYTICAL RESULTS
SWMUs 31/32
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

Sample ID	31SS05	31SS06	31SS07	31SS08	31SS09	31SS10	31SS11	31SS12
Sample Date	9/24/97	9/24/97	9/24/97	9/24/97	9/24/97	9/24/97	9/24/97	9/24/97
Depth Range (ft bgs)	0.25-0.75	0.25-0.75	0.25-0.75	0.25-0.75	0.25-0.75	0.25-0.75	0.25-0.75	0.25-0.75
Dioxins (ug/kg)								
Total HxCDD	1.50 J	0.58 J	1.40 J	0.16 J	0.03 U	0.18 U	0.17 U	0.10 U
Total HxCDF	3.30	1.70	1.80	0.40 J	0.03 U	0.19 U	0.15 U	0.10 J
Total PeCDD	0.12 U	0.01 U	0.17 U	0.02 U	0.05 U	0.03 U	0.05 UJ	0.18 U
Total PeCDF	0.52 J	0.69 J	1.10	0.29 J	0.03 U	0.03 U	0.07 J	0.14 U
Total TCDF	0.08 U	0.15 J	0.12 U	0.04 J	0.01 U	0.04 U	0.08 UJ	0.06 U

Data Qualifiers:
J = Analyte present. Reported value may not be accurate or precise.
U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.
UJ = Not Detected. Quantitation limit may be inaccurate or imprecise.

Notes:
HxCDD = Hexachlorodibenzo-p-dioxin
HxCDF = Hexachlorodibenzofuran
PeCDD = Pentachlorodibenzo-p-dioxin
PeCDF = Pentachlorodibenzofuran
TCDF = Tetrachlorodibenzofuran

ug/kg = micrograms per kilogram
ft bgs = feet below ground surface

TABLE 2-3
LIST OF DIOXIN CONGENERS AND
ASSOCIATED TCDD TOXICITY EQUIVALENCY FACTORS
SWMUs 31/32
NAVAL STATION ROOSEVELT ROADS

Congener	2,3,7,8-TCDD Toxicity Equivalency Factor[1]
Dioxins:	
Tetrachlorodibenzo-p-dioxin (TCDD)	1
Pentachlorodibenzo-p-dioxin (PeCDD)	0.5
Hexachlorodibenzo-p-dioxin (HxCDD)	0.1
Heptachlorodibenzo-p-dioxin (HpCDD)	0.01
Octachlorodibenzo-p-dioxin (OCDD)	0.001
Furans:	
Tetrachlorodibenzofuran (TCDF)	0.1
Pentachlorodibenzofuran (PeCDF)	0.5
Hexachlorodibenzofuran (HxCDF)	0.1
Heptachlorodibenzofuran (HpCDF)	0.01
Octachlorodibenzofuran (OCDF)	0.001

Note:

[1] Agency for Toxic Substances and Disease Registry (ATSDR). 1997a. Dioxin and Dioxin-Like Compounds in Soil, Part I: ATSDR Interim Policy Guideline. Journal of Clean Technology, Environmental Toxicology, and Occupational Medicine, Vol. 6, No. 2. U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry. Atlanta, Georgia.

TABLE 2-4

SUMMARY OF ADDITIONAL DIOXIN ANALYTICAL RESULTS
SWMUs 31/32
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

LOCATION	31-SS04A	31-SS05A	31-SS06A	31-SS07A	31-SS08A	31-SSA	31-SSB	31-SSC	31-SSD
SAMPLE ID	31-SS04a	31-SS05a	31-SS06a	31-SS07a	31-SS08a	31-SSA	31-SSB	31-SSC	31-SSD
SAMPLE DATE	06/28/99	06/28/99	06/26/99	06/26/99	06/26/99	06/28/99	06/28/99	06/28/99	06/28/99
DEPTH RANGE (inches bgs)	3.0-9.0	3.0-9.0	3.0-9.0	3.0-9.0	3.0-9.0	3.0-9.0	3.0-9.0	3.0-9.0	3.0-9.0
DIOXINS/FURANS (ug/Kg)									
2,3,7,8-TCDD	ND	0.00043	ND	0.0003	0.00036	0.00029	ND	ND	0.00047
TOTAL TCDD	ND	0.0054	ND	0.0003	0.00078	0.00086	ND	ND	0.0012
2,3,7,8-TCDF	ND	0.0012	0.00013	0.0023	0.0016	0.0008	ND	ND	0.00039
TOTAL TCDF	0.0015	0.1	0.085	0.44	0.21	0.12	0.0047	0.00041	0.037
1,2,3,7,8-PeCDD	ND	0.0063	0.00046	0.0039	0.0032	0.0038	0.00036	ND	0.0033
TOTAL PeCDD	ND	0.061	0.00046	0.016	0.013	0.018	0.001	ND	0.014
2,3,4,7,8-PeCDF	0.00024	0.02	0.004	0.081	0.045	0.013	0.00086	ND	0.0049
1,2,3,7,8-PeCDF	ND	0.0064	ND	0.0027	0.0019	0.0014	0.00016	ND	0.00074
TOTAL PeCDF	0.0066	0.7	0.14	1.8	1.1	0.35	0.022	0.00079	0.16
1,2,3,7,8,9-HxCDD	0.00044	0.054	0.002	0.012	0.014	0.018	0.0014	0.00022	0.015
1,2,3,4,7,8-HxCDD	0.0002	0.039	0.00077	0.0062	0.0069	0.0087	0.0007	ND	0.0067
1,2,3,6,7,8-HxCDD	0.0012	0.24	0.0045	0.027	0.023	0.026	0.002	0.00027	0.022
TOTAL HxCDD	0.006	1.1	0.024	0.19	0.15	0.2	0.014	0.0011	0.15
1,2,3,7,8,9-HxCDF	ND	0.0054	ND	0.0023	0.0014	0.00066	ND	ND	0.00072
1,2,3,6,7,8-HxCDF	0.00048	0.12	0.0012	0.02	0.017	0.011	0.00087	ND	0.0068
2,3,4,6,7,8-HxCDF	0.00058	0.068	0.0017	0.046	0.029	0.013	0.0012	ND	0.0089
1,2,3,4,7,8-HxCDF	0.00093	0.063	0.0015	0.01	0.011	0.0066	0.00057	ND	0.0049
TOTAL HxCDF	0.018	2.8	0.089	0.73	0.56	0.38	0.025	0.0016	0.26
1,2,3,4,6,7,8-HPCDD	0.033	9.2	0.11	0.5	0.58	0.69	0.054	0.0028	0.55
TOTAL HPCDD	0.06	17	0.2	0.9	1	1.3	0.1	0.0057	1
1,2,3,4,7,8,9-HPCDF	0.00068	0.1	0.0025	0.0077	0.0091	0.0076	0.00088	ND	0.0082
1,2,3,4,6,7,8-HPCDF	0.022	3.5	0.07	0.23	0.25	0.29	0.022	0.0072	0.2
TOTAL HPCDF	0.048	12	0.18	0.57	0.57	0.62	0.051	0.013	0.51
OCDD	0.36	130	1.2	3.8	5.8	6.2	0.49	0.028	5.9
OCDF	0.039	16	0.18	0.48	0.45	0.42	0.036	0.0047	0.42

Notes:

TCDD = Tetrachlorodibenzo-p-dioxin
TCDF = Tetrachlorodibenzofuran
PeCDD = Pentachlorodibenzo-p-dioxin
PeCDF = Pentachlorodibenzofuran
HxCDD = Hexachlorodibenzo-p-dioxin
HxCDF = Hexachlorodibenzofuran
HPCDD = Heptachlorodibenzo-p-dioxin
HPCDF = Heptachlorodibenzofuran
OCDD = Octachlorodibenzo-p-dioxin
OCDF = Octachlorodibenzofuran

ND = Not Detected.
ug/kg = micrograms per kilogram
bgs = below ground surface

TABLE 2-4

SUMMARY OF ADDITIONAL DIOXIN ANALYTICAL RESULTS
SWMUs 31/32
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

LOCATION	31-SSE	31-SSF	31-SSG	31-SSAA	31-SSBB	31-SSCC	31-SSDD	31-SSEE	31-SSFF
SAMPLE ID	31-SSE	31-SSF	31-SSG	31-SSAA	31-SSBB	31-SSCC	31-SSDD	31-SSEE	31-SSFF
SAMPLE DATE	06/28/99	06/28/99	06/28/99	06/26/99	06/28/99	06/28/99	06/28/99	06/28/99	06/28/99
DEPTH RANGE (inches bgs)	3.0-9.0	3.0-9.0	3.0-9.0	3.0-9.0	3.0-9.0	3.0-9.0	3.0-9.0	3.0-9.0	3.0-9.0
DIOXINS/FURANS (ug/Kg)									
2,3,7,8-TCDD	ND	0.0031	ND	ND	ND	ND	0.11	ND	ND
TOTAL TCDD	ND	0.0034	ND	ND	ND	ND	0.11	ND	ND
2,3,7,8-TCDF	ND	0.0006	0.00021	ND	ND	ND	0.0011	ND	ND
TOTAL TCDF	0.00033	0.044	0.02	0.0015	0.00044	0.00035	0.04	ND	0.014
1,2,3,7,8-PeCDD	ND	0.003	0.00032	ND	ND	ND	0.0035	ND	0.00071
TOTAL PeCDD	ND	0.014	0.0017	ND	ND	ND	0.049	ND	0.0024
2,3,4,7,8-PeCDF	ND	0.0074	0.0021	ND	ND	ND	0.0079	ND	ND
1,2,3,7,8-PeCDF	ND	0.00094	ND	ND	ND	ND	0.0014	ND	ND
TOTAL PeCDF	0.0015	0.23	0.06	0.0094	0.0033	0.001	0.26	0.00052	0.016
1,2,3,7,8,9-HxCDD	ND	0.012	0.0013	0.0012	0.00068	ND	0.022	ND	0.0036
1,2,3,4,7,8-HxCDD	ND	0.0062	0.00053	0.00047	ND	ND	0.01	ND	0.0016
1,2,3,6,7,8-HxCDD	ND	0.018	0.002	0.0018	0.0011	ND	0.061	ND	0.0046
TOTAL HxCDD	ND	0.19	0.014	0.011	0.0054	0.00062	0.43	ND	0.025
1,2,3,7,8,9-HxCDF	ND	0.00049	ND	ND	ND	ND	0.00082	ND	ND
1,2,3,6,7,8-HxCDF	ND	0.0084	0.0012	ND	ND	ND	0.012	ND	0.00094
2,3,4,6,7,8-HxCDF	ND	0.01	0.0017	0.00049	0.00035	ND	0.018	ND	0.00084
1,2,3,4,7,8-HxCDF	ND	0.0045	0.0006	ND	ND	ND	0.0092	ND	0.00079
TOTAL HxCDF	0.00056	0.26	0.04	0.017	0.0077	0.0011	0.57	0.00056	0.024
1,2,3,4,6,7,8-HPCDD	0.00066	0.48	0.058	0.05	0.027	0.0021	2	0.0039	0.1
TOTAL HPCDD	0.00066	1	0.11	0.091	0.049	0.0039	3.6	0.0067	0.18
1,2,3,4,7,8,9-HPCDF	ND	0.0045	ND	0.00095	ND	ND	0.02	ND	0.0012
1,2,3,4,6,7,8-HPCDF	0.00046	0.18	0.021	0.018	0.0092	0.0013	0.46	0.0009	0.023
TOTAL HPCDF	0.00074	0.35	0.052	0.046	0.026	0.0027	1.7	0.0019	0.046
OCDD	0.0024	4.6	0.76	0.59	0.32	0.018	27	0.034	0.9
OCDF	ND	0.24	0.046	0.04	0.026	0.0021	1.9	0.0014	0.032

Notes:

TCDD = Tetrachlorodibenzo-p-dioxin
TCDF = Tetrachlorodibenzofuran
PeCDD = Pentachlorodibenzo-p-dioxin
PeCDF = Pentachlorodibenzofuran
HxCDD = Hexachlorodibenzo-p-dioxin
HxCDF = Hexachlorodibenzofuran
HPCDD = Heptachlorodibenzo-p-dioxin
HPCDF = Heptachlorodibenzofuran
OCDD = Octachlorodibenzo-p-dioxin
OCDF = Octachlorodibenzofuran

ND = Not Detected.
ug/kg = micrograms per kilogram
bgs = below ground surface

TABLE 3-1

SUMMARY OF 2,3,7,8-TCDD
EQUIVALENTS FOR THE ADDITIONAL DIOXIN ANALYTICAL RESULTS
SWMUs 31/32
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

LOCATION	31-SS04A	31-SS05A	31-SS06A	31-SS07A	31-SS08A	31-SSA	31-SSB	31-SSC	31-SSD	31-SS04AAD
SAMPLE ID	31-SS04a	31-SS05a	31-SS06a	31-SS07a	31-SS08a	31-SSA	31-SSB	31-SSC	31-SSD	31-SS04AaD
SAMPLE DATE	06/28/99	06/28/99	06/26/99	06/26/99	06/26/99	06/28/99	06/28/99	06/28/99	06/28/99	06/28/99
DEPTH RANGE (inches bgs)	3.0-9.0	3.0-9.0	3.0-9.0	3.0-9.0	3.0-9.0	3.0-9.0	3.0-9.0	3.0-9.0	3.0-9.0	3.0-9.0
DIOXINS (ug/Kg)										
Total as 2,3,7,8-TCDD	0.0014588	0.34984	0.006615	0.068337	0.050441	0.034362	0.0026588	0.0001817	0.025734	0.0016956

	31-SSE	31-SSF	31-SSG	31-SSAA	31-SSBB	31-SSCC	31-SSDD	31-SSEE	31-SSFF	31-SSFD
	31-SSE	31-SSF	31-SSG	31-SSAA	31-SSBB	31-SSCC	31-SSDD	31-SSEE	31-SSFF	31-SSFD
	06/28/99	06/28/99	06/28/99	06/26/99	06/28/99	06/28/99	06/28/99	06/28/99	06/28/99	06/28/99
	3.0-9.0	3.0-9.0	3.0-9.0	3.0-9.0	3.0-9.0	3.0-9.0	3.0-9.0	3.0-9.0	3.0-9.0	3.0-9.0
DIOXINS (ug/Kg)										
Total as 2,3,7,8-TCDD	0.0000136	0.026814	0.003749	0.0017155	0.000921	0.0000541	0.184502	0.0000834	0.003766	0.06661

Notes:
TCDD - Tetrachlorodibenzo-p-dioxin
ug/kg - micrograms per kilogram
bgs - below ground surface

FIGURES

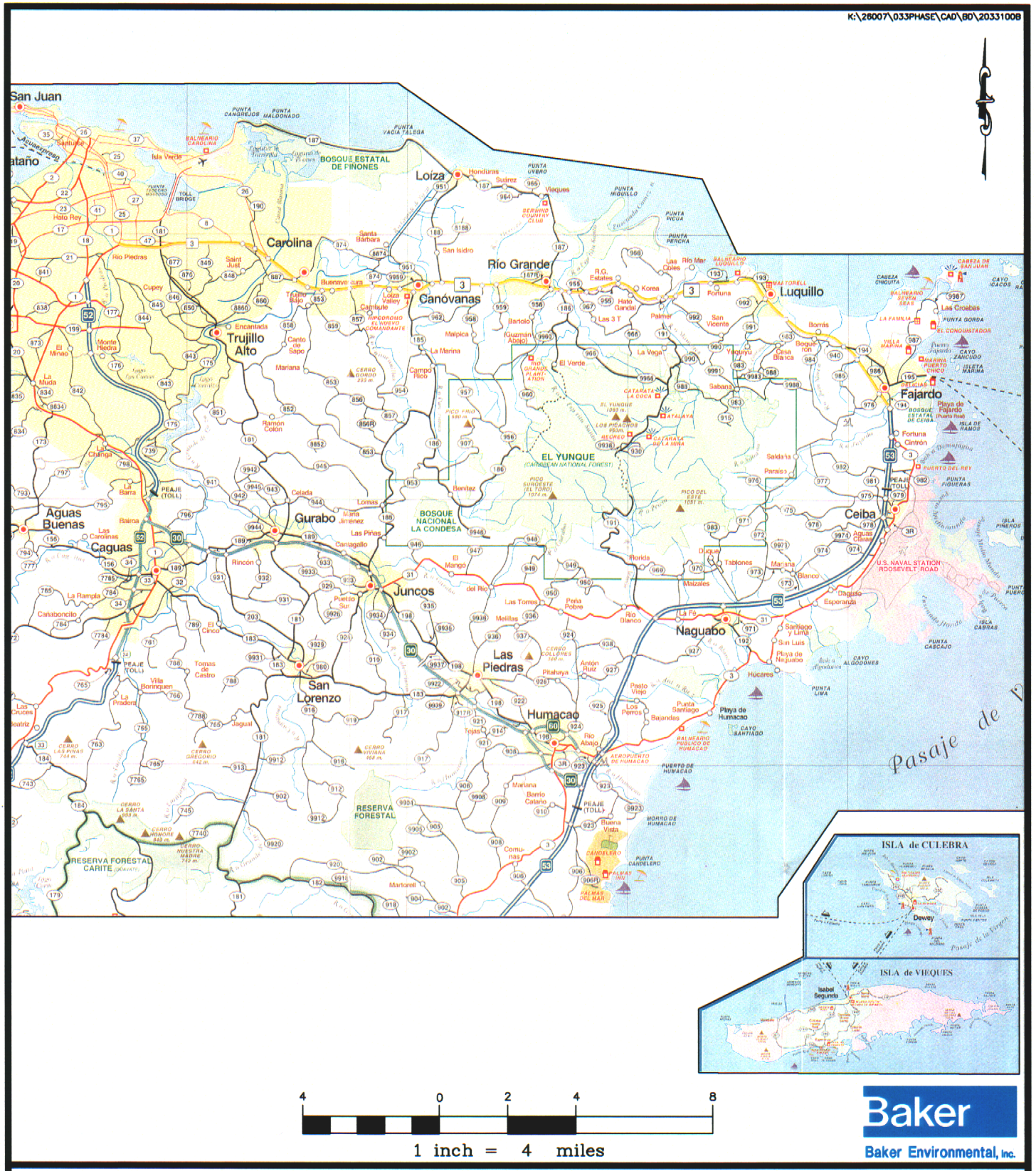


FIGURE 1–1
REGIONAL LOCATION MAP
BASIS OF DESIGN

NAVAL STATION ROOSEVELT ROADS
PUERTO RICO

SOURCE: METRODATA, INC., 1999.

2033107B

51
GATE NO.2
37
12/14
BASE BOUNDARY
AGRICULTURAL
OBSTRUCTION LIGHTS
9
MANGROVE
MEDIO MUNDO PASSAGE
PINERITA ISLAND
25
13
9
7/8
AOC D
46/AOC C
6/AOC B
PUERCA POINT
2
10
23/24
21/32
AOC D
39
FORRESTAL DRIVE
45/11
30
AOC D
3
1
ENSENADA
AOC D
HONDA
MANGROVE
MANGROVE
MANGROVE
MANGROVE
26
AGRICULTURAL
MANGROVE
VIEQUES PASSAGE

Baker
Baker Environmental, Inc.

LEGEND

1 – SWMUs

AOC D – AOCs

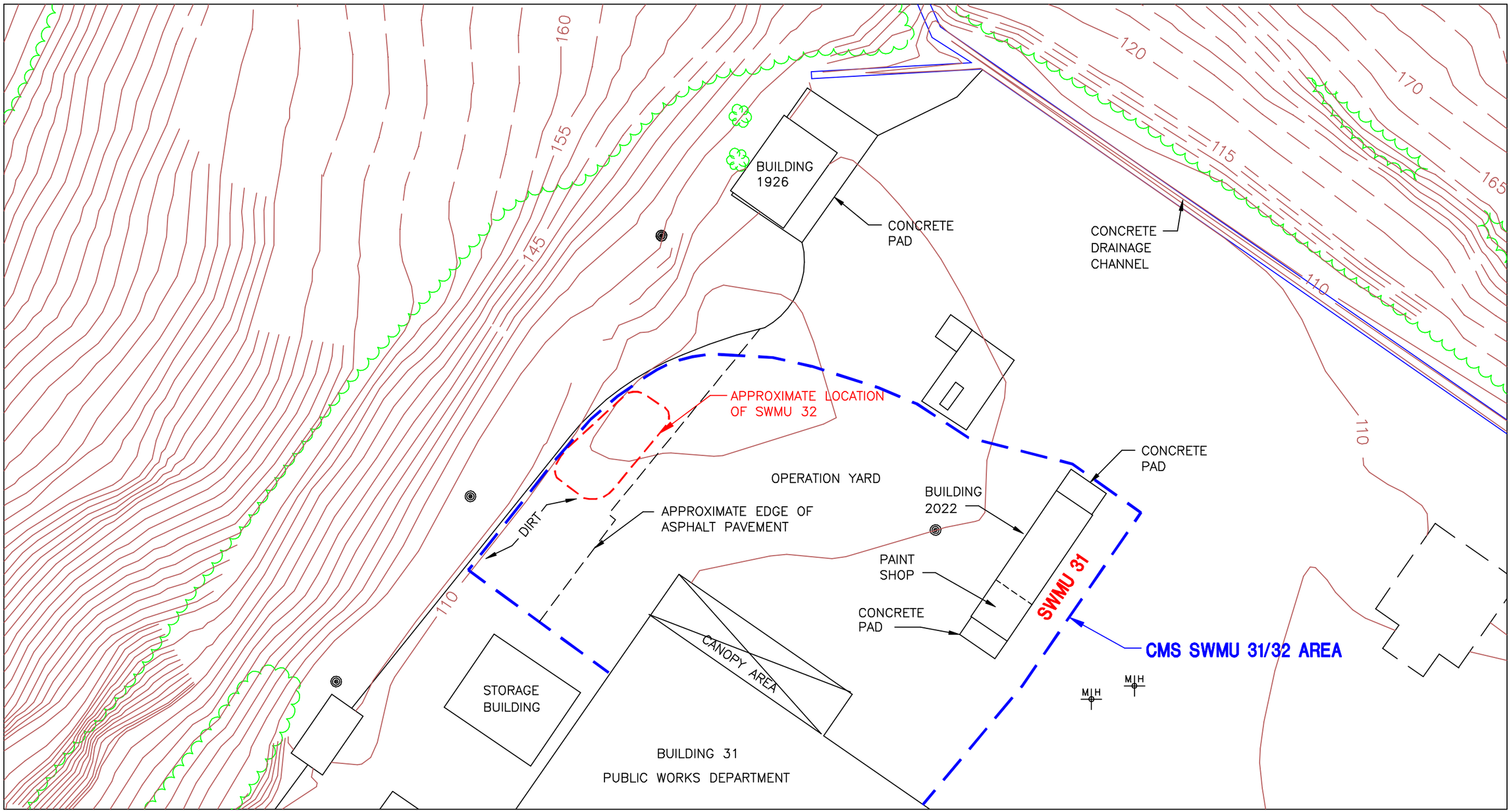
31/32 – AREA FOR WHICH THIS INVESTIGATION PERTAINS TO

SOURCE: LANTDIV, FEB. 1992/1997

2500 0 1250 2500
1 inch = 2500 ft.

FIGURE 1–2
SWMU/AOC LOCATION MAP
BASIS OF DESIGN
NAVAL STATION ROOSEVELT ROADS
PUERTO RICO

2033108B



Baker
Baker Environmental, Inc.

LEGEND

110 SURFACE ELEVATION CONTOUR

UTILITY POLE

MANHOLE

TREELINE

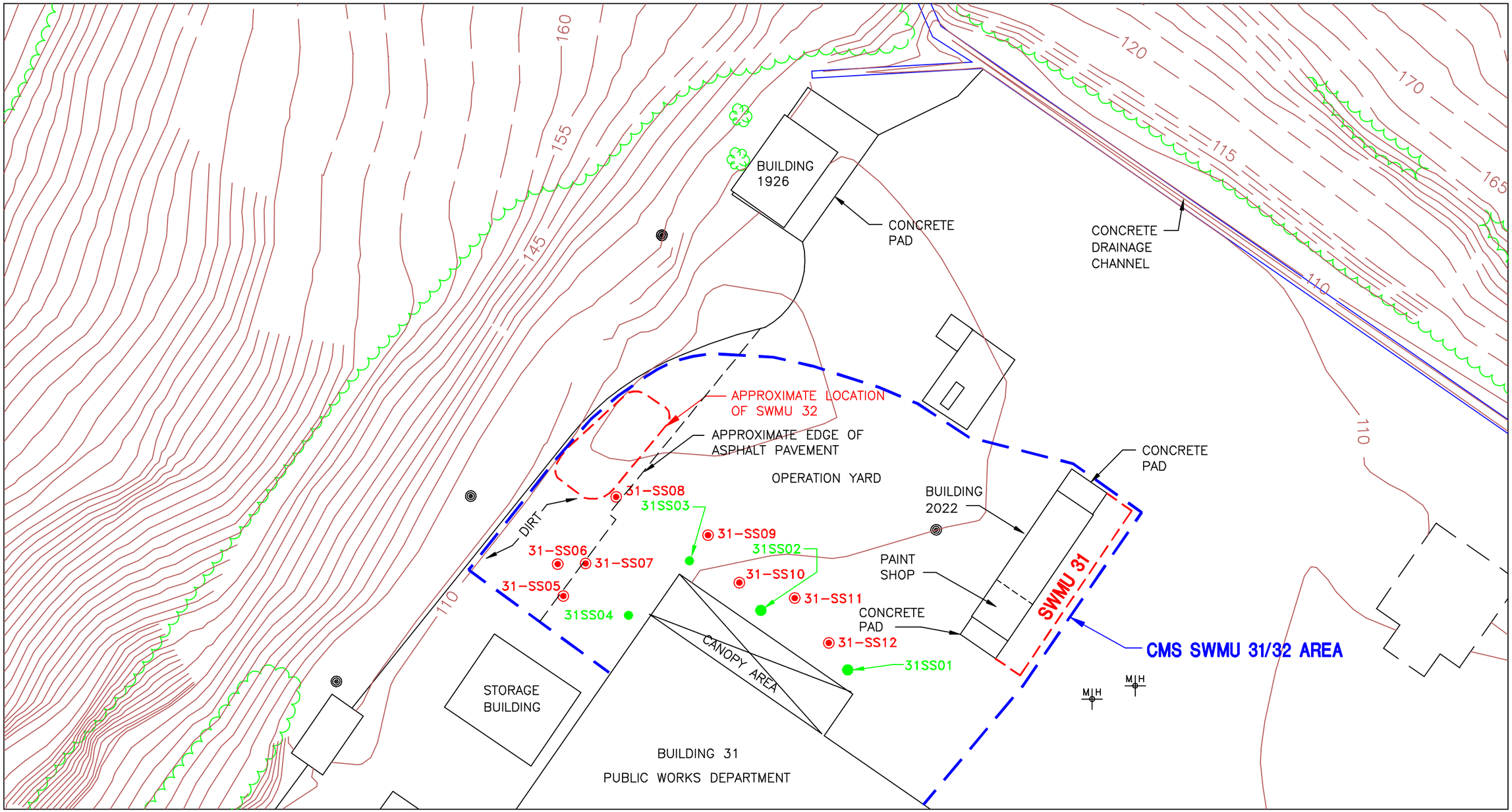
SOURCE: LANTDIV, FEB. 1992/1997

50 0 25 50

1 inch = 50 ft.

FIGURE 1-3
SWMU 31/32 SITE PLAN
BASIS OF DESIGN
NAVAL STATION ROOSEVELT ROADS
PUERTO RICO

2033109B



Baker
Baker Environmental, Inc.

LEGEND

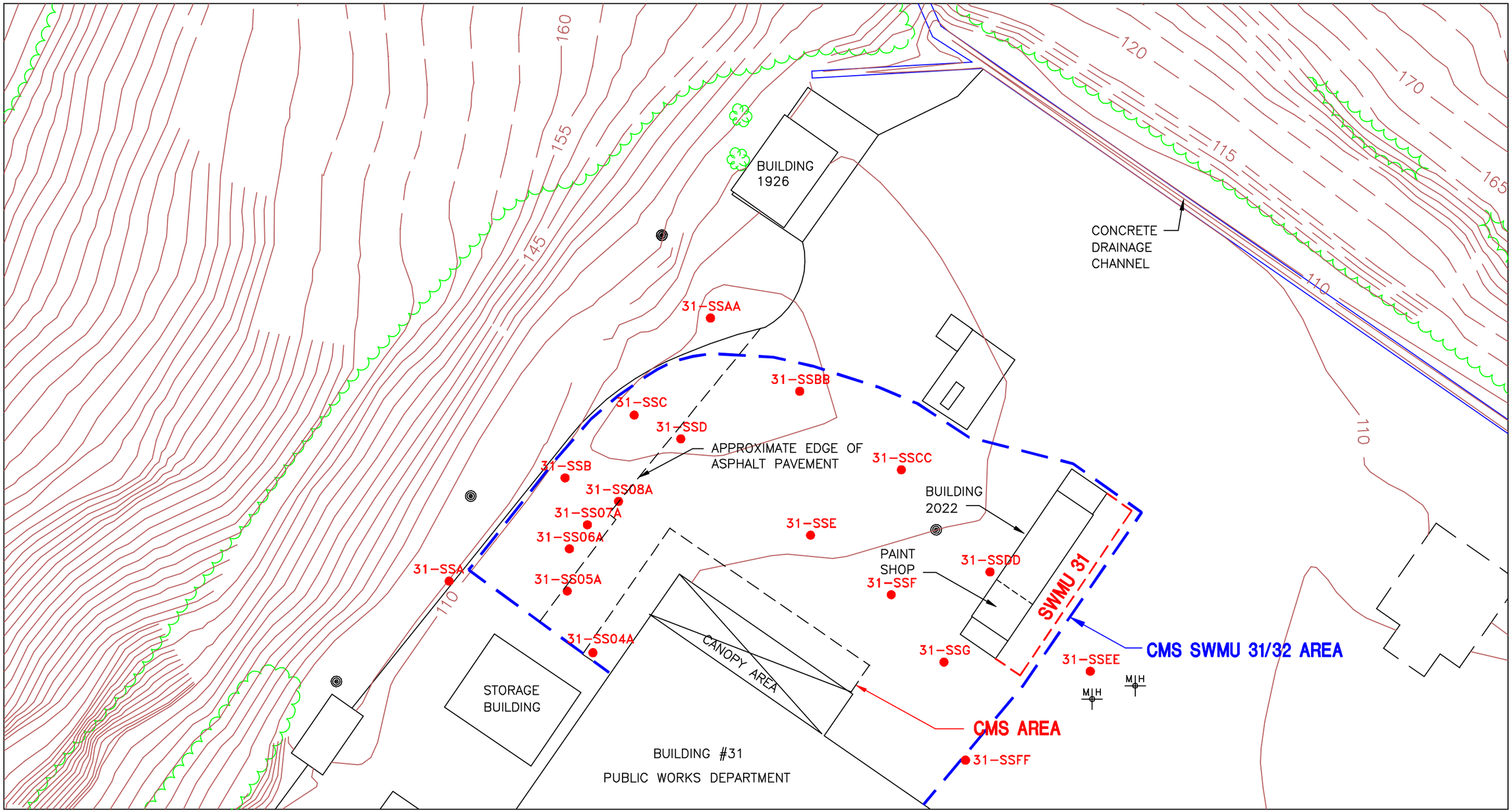
- SOIL SAMPLING LOCATION (PHASE I RFI)
- SURFACE SOIL SAMPLING LOCATION (PHASE II RFI)
- 110 SURFACE ELEVATION CONTOUR
- UTILITY POLE
- MH MANHOLE
- TREELINE

SOURCE: LANTDIV, FEB. 1992/1997

50 0 25 50
1 inch = 50 ft.

FIGURE 2-1
SWMU 31/32 RFI SAMPLE LOCATIONS
BASIS OF DESIGN
NAVAL STATION ROOSEVELT ROADS
PUERTO RICO

2033110B



Baker

Baker Environmental, Inc.

LEGEND

- SOIL SAMPLING LOCATION
- 110 SURFACE ELEVATION CONTOUR
- UTILITY POLE
- M|H MANHOLE
- TREELINE

SOURCE: LANTDIV, FEB. 1992/1997

50 0 25 50

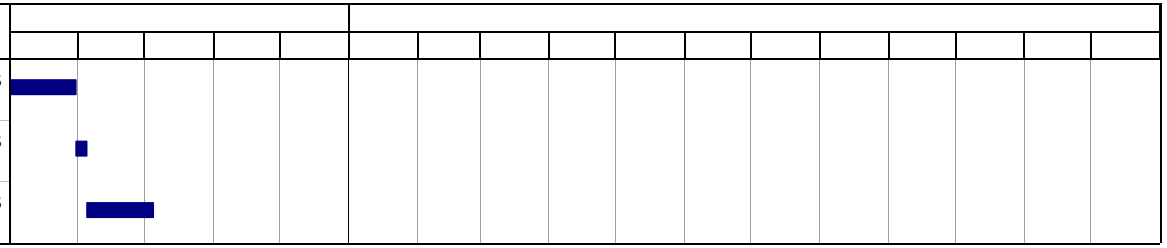
1 inch = 50 ft.

FIGURE 2-2
ADDITIONAL SWMU 31/32 DIOXIN SAMPLE LOCATIONS
BASIS OF DESIGN
NAVAL STATION ROOSEVELT ROADS
PUERTO RICO

APPENDIX A
CONSTRUCTION SCHEDULE

APPENDIX A
CONSTRUCTION SCHEDULE
SWMU 31/32
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

Task Name	Duration
Mobilization and Preparatory Work	30 edays
SWMU 31/32 Site Work	5 edays
Demobilization and Closeout Reporting	30 edays



Project: Roosevelt Roads
Date: 7/25/00

Task

APPENDIX B
SUPPORTING CALCULATIONS

S.O. No. 26007-033-0000-04500

Subject: ASPHALT CAP FOR SWMW 31/32

SUPPORTING CALCULATIONS Sheet No. 1 of 2

Drawing No.

Computed by WMP Checked By Date 7/17/00

Baker

DETERMINE REQUIRED ASPHALT PAVEMENT DESIGN FOR UNPAVED PARKING LOT. THE DESIGN SHALL OVERLAY THE EXISTING PAVING AND IS COMPRISED OF TWO LAYERS: STONE BASE COURSE AND BITUMINOUS CONCRETE (BC) SURFACE COURSE.

ASSUMPTIONS:

EXISTING GRADE "UNPAVED AREA" IS A MEDIUM STIFF SILTY SAND WHICH HAS BEEN COMPACTED BY VEHICLE TRAFFIC. COMPACTION NOT NECESSARY.

DESIGN TRAFFIC LOAD - 10 LARGE VEHICLE CROSSING ASPHALT PAVEMENT PER DAY (1 LARGE VEHICLE HAS THE EQUIVALENT OF 5 AXLES AT 18,000 LBS/AXLE) BASED ON SEMI-TRACTOR/TRAILER VEHICLE WEIGHT 18 KIP × 5 = 90,000 LBS

PAVEMENT TERMINAL SERVICEABILITY = 20 YEARS ($P_t = 2.0$)

NO GRADING OR EXCAVATION OF EXISTING "UNPAVED" GRADE

STONE BASE COURSE EQUIVALENT TO AASHTO SANDY GRAVEL

BC SURFACE COURSE EQUIVALENT TO AASHTO PLANT MIX (HIGH STABILITY)

DESIGN LAYER-THICKNESS EQUATION REFERENCE [1]

$$SN = t_{BASE}\,\alpha_{base} + t_{SURFACE}\,\alpha_{SURFACE}$$

$SN = 2.2$ (SEE FIGURE 1)

$2.2 = 0.11\,t_{BASE} + 0.20\,t_{SURFACE}$

$t_{BASE} = 4$ INCH MINIMUM (REF [1])

$1.76 = 0.32\,t_{SURFACE}$

$t_{SURFACE} = 5.5$ INCH; USE 6.0 INCH

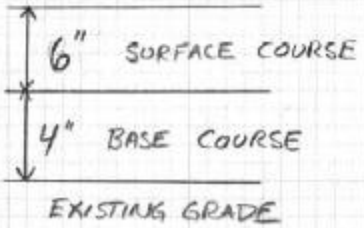
SN = STRUCTURAL NUMBER FROM NOMOGRAPH FIGURE 1

t_{BASE} = THICKNESS OF BASE COURSE

α_{BASE} = BASE COURSE COEFFICIENT 0.11 REF [1]

$t_{SURFACE}$ = THICKNESS OF SURFACE COURSE

$\alpha_{SURFACE}$ = SURFACE COURSE COEFFICIENT
0.2 FOR ROAD MIX REF [1]
0.44 FOR PLANT MIX REF [1]
SOURCE UNKNOWN USE MEAN
$\alpha_{SURFACE} = 0.32$



S.O. No. 26007-033-0000-04500

Subject: ASPHALT CAP FOR SWMU 31/32

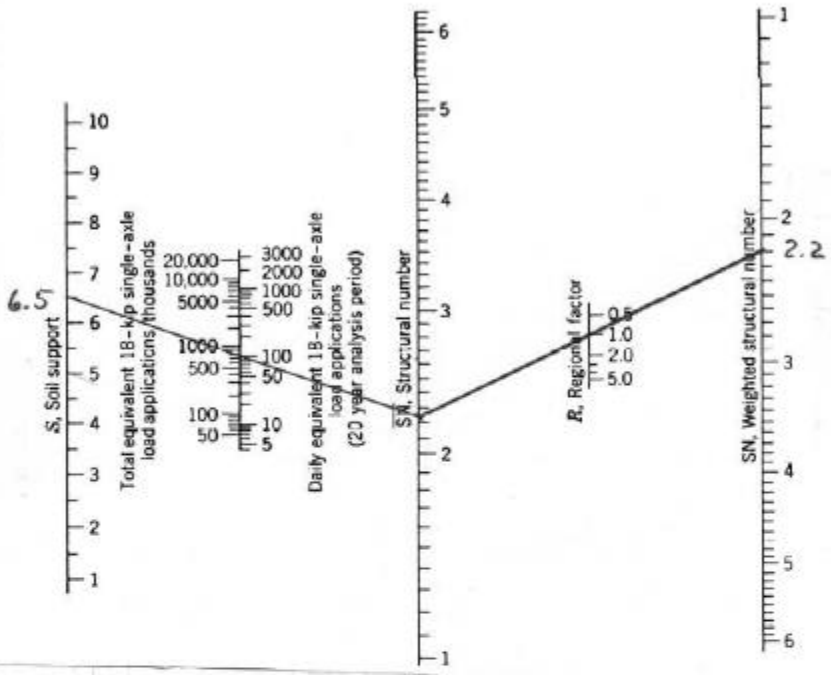
SUPPORTING CALCS,

Sheet No. 2 of 2

Drawing No.

Computed by WMP Checked By Date 7/17/00

Baker



AASHTO Flexible Pavement
Design Nomograph
(Terminal Serviceability, $p_t = 2.0$)

INPUT PARAMETERS FOR NOMOGRAPH

S, SUPPORT SOIL = 6.5 FOR SILTY SAND REF [1] USE MIDPOINT BETWEEN S=10, ROCK AND S=3, CLAY

DAILY EQUIVALENT 18-KIP SINGLE AXLE LOAD APPLICATIONS

10 VEHICLE X 5 AXLES = 50 LOADS/DAY

USE 2.0 SAFETY FACTOR = 2 X 50 = 100 DAILY LOAD APPLIED

R, REGIONAL FACTOR = 1.0 FOR DRY SUMMER CONDITIONS

REFERENCES

[1] AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO), "GUIDE FOR DESIGN OF PAVEMENT STRUCTURES", 1993.